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SPECIFICATION

TITLE OF THE INVENTION

MAGNETIC FORCE ROTATING APPARATUS

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a magnetic force rotating apparatus rotating a rotary body by utilizing a magnetic force, in particular, to a magnetic force rotating apparatus utilizing a permanent magnet and an electromagnet.

BACKGROUND ART

Conventionally, as a magnetic force rotating apparatus of this kind, there has been proposed, for example, a magnetic force rotating apparatus (hereinafter, refer to as a "conventional apparatus") described in Japanese Unexamined Patent Publication No. 7-87725. The conventional apparatus is provided with a rotatable rotary shaft; a rotary body having a permanent magnet apparatus in which a plurality of permanent magnets are arranged on a rotary table at a predetermined position and in a predetermined direction, having means for keeping a rotational balance and being fixed to the rotary shaft, electromagnet means provided so as to be opposed to the magnet apparatus of the rotary body and generating a magnetic field opposing to a magnetic field from the magnet

apparatus, and control means detecting a rotational position of the rotary body so as to control the electromagnet means, and is structured such as to intermittently excite the electromagnet means at a predetermined timing.

The conventional apparatus mentioned above is structured such as to rotate by utilizing a repulsive force between the permanent magnet and the electromagnet, and it is possible to generate a rotational torque with a high efficiency due to a strain of the magnetic field between the permanent magnet and the electromagnet by this apparatus, whereby it is possible to take out an increased output energy with respect to an input energy.

In this case, the magnet potentially keeps a repulsive force and an attraction force, however, since the conventional apparatus is mainly dependent upon only the repulsive force between the opposing magnets as means for rotating the rotary body, there is a unsatisfied point in view of the increase of the rotational energy with respect to the input energy, and there remains a problem in view of a stability of rotational movement of the rotary body.

The present invention is made by taking the matters mentioned above into consideration. An object of the

present invention is to provide a novel magnetic force rotating apparatus which can simultaneously apply a repulsive force and an attraction force potentially kept in a magnet so as to effectively utilize, further develop the increase of a rotational energy with respect to an input energy, generate a rotational torque with a higher efficiency, and secure a stability of a rotational movement of the rotary body.

DISCLOSURE OF THE PRESENT INVENTION

In order to achieve the object mentioned above, in accordance with one aspect of the present invention, there is provided a magnetic force rotating apparatus comprising:

a rotatable rotary body;

a permanent magnet apparatus in which a plurality of permanent magnets are arranged so as to direct one magnetic pole among mutually corresponding poles to a rotational direction and another magnetic pole to an inverse rotational direction at a substantially uniform interval in a circumferential direction, the permanent magnet apparatus being provided along a circumference in an outer peripheral portion of the rotary body;

electromagnet means having two different magnetic poles so as to generate two different magnetic fields and provided so as to simultaneously apply a rotational

energy in one direction in opposite to the magnetic field from the magnet apparatus; and

a control unit intermittently exciting the electromagnet means.

In accordance with the present invention, the structure can be made such that a plurality of permanent magnets provided in the rotary body are provided at a substantially uniform interval in a circumferential direction with applying a substantially fixed angle of incline with respect to a side surface of the rotary body and in such a manner as to partly overlap the adjacent magnets with each other.

In accordance with the present invention, a number (a number of sets) of the permanent magnet apparatus provided in the rotary body is not particularly limited, and one or plural sets can be optionally provided. Besides, a balancer for keeping a balance with the permanent magnet apparatus can be provided in the rotary body. Moreover, a number of the electromagnet means to be provided is not limited.

Further, in the present invention, the permanent magnet apparatus can structured such that a plurality of permanent magnets are arranged at a substantially uniform interval in a circumferential direction so that one magnetic pole among the mutually corresponding

magnetic poles is positioned in one side surface portion of the rotary body so as to be directed to a rotational direction and another magnetic pole is positioned in another side surface portion of the rotary body so as to be directed to an inverse rotational direction, and the electromagnet means is provided so as to be opposed to the magnetic field output from the magnet apparatus. However, even in this case, a plurality of permanent magnets provided in the rotary body can be provided at a substantially uniform interval in a circumferential direction with applying a substantially fixed angle of incline with respect to a side surface of the rotary body and in such a manner as to partly overlap the adjacent magnets with each other. In accordance with the invention having the structure mentioned above, the electromagnet means can be opposed to the respective magnetic fields output from one and another magnetic poles of the magnet apparatus, and two sets of the electromagnet means can be provided so as to form a pair. In this case, in this specification, the wordings "partly overlap the magnets with each other" means a state in which one magnetic pole of the magnet is positioned between one and another magnetic poles of the mutually adjacent magnets in the case of viewing the permanent magnet apparatus from the side surface

of the rotary body except the case of being described in a limited manner. Further, the wordings "a substantially fixed" in the description "a substantially fixed angle of incline" is used as a meaning including a fixed state and a state close thereto, and the wordings "a substantially uniform" in the description "a substantially uniform interval" is used as a meaning including a uniform state and a state close thereto.

In accordance with another aspect of the present invention, there is provided a magnetic force rotating apparatus comprising:

a rotatable rotary body;

a permanent magnet apparatus in which a plurality of permanent magnets are arranged so as to position one magnetic pole among mutually corresponding poles in an outer peripheral side of the rotary body and another magnetic pole in an inner peripheral side of the rotary body and arrange magnetic pole pairs of the respective magnet at a uniform interval in a circumferential direction with applying a substantially fixed angle of incline with respect to a radial line of the rotary body, the permanent magnet apparatus being provided along a circumference in an outer peripheral portion of the rotary body;

electromagnet means having two different magnetic poles so as to generate two different magnetic fields and provided so as to simultaneously apply a rotational energy in one direction in opposite to the magnetic field from the magnet apparatus; and

a control unit intermittently exciting the electromagnet means.

In the another aspect of the present invention, a number (a number of sets) of the permanent magnet apparatus provided in the rotary body is not particularly limited, and one or plural sets can be optionally provided. Besides, a balancer for keeping a balance with the permanent magnet apparatus can be provided in the rotary body. Moreover, a number of the electromagnet means to be provided is not limited.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B are respectively a front elevational view and a side elevational view showing an embodiment 1 of a magnetic force rotating apparatus in accordance with the present invention;

Fig. 2 is a perspective view showing a mounting and arranging state of a single piece of a permanent magnet constituting a permanent magnet apparatus in the magnetic force rotating apparatus shown in Figs. 1 and 4;

Fig. 3 is a diagram of an electric circuit of electromagnet means of the apparatus mentioned above;

Figs. 4A and 4B are respectively a front elevational view and a side elevational view showing an embodiment 2 of a magnetic force rotating apparatus in accordance with the present invention;

Figs. 5A and 5B are respectively a front elevational view and a side elevational view showing an embodiment 3 of a magnetic force rotating apparatus in accordance with the present invention;

Fig. 6 is a perspective view showing a state before mounting and arranging a single piece of a permanent magnet constituting a permanent magnet apparatus in the magnetic force rotating apparatus shown in Figs. 5 and 9;

Fig. 7 is a diagram of an electric circuit of electromagnet means of the magnetic force rotating apparatus shown in Figs. 5, 8 and 9;

Figs. 8A and 8B are respectively a front elevational view showing an embodiment 4 of a magnetic force rotating apparatus in accordance with the present invention and a perspective view showing a main portion thereof;

Figs. 9A and 9B are respectively a front elevational view and a side elevational view showing

an embodiment 5 of a magnetic force rotating apparatus in accordance with the present invention;

Fig. 10 is a side elevational view showing an embodiment 6 of a magnetic force rotating apparatus in accordance with the present invention;

Fig. 11 is a perspective view showing a mounting and arranging relation of a single piece of a permanent magnet constituting a permanent magnet apparatus in the magnetic force rotating apparatus shown in Figs. 10 and 12; and

Fig. 12 is a side elevational view showing an embodiment 7 of a magnetic force rotating apparatus in accordance with the present invention.

MOST PREFERRED EMBODIMENTS OF THE INVENTION

A description will be given below of examples of embodiments in accordance with the present invention with reference to the accompanying drawings.

Figs. 1 to 3 show an embodiment 1 in accordance with the present invention, in which Fig. 1A is a front elevational view of a magnetic force rotating apparatus, Fig. 1B is a side elevational view thereof, Fig. 2 is a perspective view showing a mounting and arranging state of a single piece of a permanent magnet constituting a permanent magnet apparatus, and Fig. 3 is a diagram of an electric circuit of electromagnet

means.

In these drawings, a magnetic force rotating apparatus in accordance with the embodiment 1 is provided with a rotatable rotary body 1, a permanent magnet apparatus 2 mounted to the rotary body 1, electromagnet means 3 provided close to the rotary body 1 and control means 4 for controlling the electromagnet means 3.

Then, the rotary body 1 is fixed onto a rotary shaft 11 provided so as to be rotatably supported. Further, the illustrated rotary body 1 is constituted of a disc, however, it is a matter of course that the rotary body can be changed to an optional structure such as a ring-like plate provided with a radial spoke supporting rod or the like in addition to the illustrated structure.

Two sets of permanent magnet apparatuses 2 are provided in this embodiment, are opposed to each other with respect to the rotary shaft 11 in the center and are provided on a circumference in an outer peripheral portion of the rotary body 1 with keeping a rotational balance. These magnet apparatuses 2 are formed so as to have the same structure, and each of the apparatuses 2 is structured such that a plurality of permanent magnets 21 are arranged at a substantially uniform interval in a circumferential direction and with partly

overlapping the adjacent permanent magnets 21 with each other in such a manner as to correspond mutual directions of magnetic poles to each other, direct one magnetic pole N of the magnetic pole pair to a rotational direction of the rotary body 1 (a direction of an arrow in Fig. 1B), direct another magnetic pole S to an inverse rotational direction (in this case, the directions of the N pole and the S pole may be inverted) and incline at a substantially fixed angle θ with respect to a side surface of the rotary body 1. The permanent magnet 21 in accordance with this embodiment is formed in a square plate shape, and is mounted to the outer peripheral portion of the side surface of the rotary body 1 via a mounting seat 22 in an attitude inclined at a fixed angle θ with respect to the side surface of the rotary body 1 so that each of the magnets 21 is positioned on the same circumference, one magnetic pole N is close to the side surface of the rotary body 1 and another magnetic pole S is apart from the rotary body 1. Then, the respective magnets 21 are arranged at a substantially uniform interval with partly overlapping the adjacent magnets 21 with each other (about half in the illustrated structure). In this embodiment, the illustration is given of a structure in which one set

of permanent magnet apparatus 2 is constituted of three permanent magnets 21, however, a number of the magnets 21 constituting one set of magnet apparatus 2 can be optionally increased and reduced.

Further, the angle θ of each of the magnets 21 is applied so as to partly overlap the adjacent magnets 21 with each other so as to arrange in a predetermined attitude, a numeral of the angle of incline θ is not an important element, and can be changed in correspondence to a thickness of the used magnet, an overlapping degree or the like.

The electromagnet means 3 is formed in a fork shape accompanying magnetic path constituting means, has two different magnetic poles N and S, is structured such as to simultaneously generate two different magnetic fields opposing to the magnetic field output from the magnet apparatus 2, and is supported by a supporting member (not shown) in such a manner as to oppose near the magnet apparatus 2 so as to be provided in a side surface side of the rotary body 1. In this embodiment, one set each of electromagnet means 3 are provided so as to oppose to each of the magnet apparatuses 2 respectively, however, only either of the sets may be provided. In this case, it is preferable that in the

electromagnet means 3, both of the magnet poles N and S are placed in a vertical direction with respect to the side surface of the rotary body 1.

As shown in Fig. 3 the electromagnet means 3 in accordance with this embodiment has two rod-like electromagnets 32a and 32b respectively obtained by connecting in series two coils C1 and C2 which are wound in same winding numbers around two shafts 31a and 31b is connected with a yoke 34 in such a manner as to opposing both of the electromagnets 32a and 32b to each other at a predetermined interval in parallel. The yoke 34 is formed in a fork shape as magnetic path constituting means, and is structured such that an end portion of the shaft 31a in a side of the coil C1 is set to an N pole, an end portion of the shaft 31b in a side of the coil C2 is set to an S pole, and two different magnetic fields (N and S) are simultaneously generated from both of the magnetic poles.

The electromagnet means 3 is provided by being positioned so as to simultaneously generates two different magnetic fields in such a manner as to oppose to the magnetic field output from the magnet apparatus 2, and simultaneously apply a rotational energy in one direction. The electromagnet means 3 in accordance with this embodiment is fixed by connecting both of the

electromagnets 32a and 32b with setting an interval between both of the electromagnets 32a and 32b with the yoke 34 capable of forming the magnetic path so that centers (shown by a dotted line in Fig. 1A) of the axial end portions (N and S) generating two magnetic fields comprising the N pole and the S pole oppose to a substantially center of the magnet 21 having a magnetic pole pair shown by N1-S1 in the N pole and to an end portion (S pole) of the magnet 21 having a magnetic pole pair shown by N2-S2 in the S pole. The yoke 34 corresponding to the magnetic path constituting means prevents the magnetic field from being leaked and achieves a function of condensing lines of magnetic force to the end portions of the N and S poles so as to effectively use. In Fig. 1A, dotted lines Na, Sa → So denotes a starting point at which the electromagnet means 3 is energized (excited) so as to start encouraging, and dotted lines Nb, Sb → Eo denotes a terminal point at which the excitation is stopped so as to be discouraged.

In this case, since the coils C1 and C2 of the electromagnets 32a and 32b are connected in series, a magnitude of the resistance becomes accordingly just twice the case of one coil C1 or C2. Accordingly, a

current stream is reduced to half the case of the single coil such as the coil C1 or C2, under a fixed voltage. Therefore, strengths of the magnetic field generated from both of the magnetic poles N and S of the electromagnet means 3 are respectively reduced to one half, however, since two different magnetic force applications, that is, a repulsive force (+ 1/2) and an attraction force (- 1/2) are simultaneously applied as a rotational energy in one direction, the rotational energy is not changed and becomes 1 although the current stream is quite at one half. This can be expressed by the following formula 1. That is, it is possible to extremely effectively take out the rotational energy at a degree that an output 2 (including a loss) can be obtained from an input 1.

Formula 1

$$|+1/2|+|-1/2|=1/2+1/2=1$$

The electromagnet 3 is controlled by the control unit 4. The control unit is provided with detecting means detecting a rotational position of the rotary body 1, and is structured such as to intermittently flows an electric current output from a power source 4 (direct current) to the electromagnet means 3 at a predetermined timing so as to excite, and apply (encourage) a rotational force to the rotary body 1.

The magnetic force rotating apparatus in accordance with the embodiment 1 is structured in the manner mentioned above. Next, a description will be given of an operation and the like. When the control unit 4 is driven and the electric current is applied to the electromagnetic means 3, the different magnetic fields are simultaneously generated from both of the magnetic poles N and S. Since the structure is made such that two different magnetic fields mentioned above are generated between the magnets 21 in one set of magnetic apparatuses 2 having the same structure, lines of magnetic force get out of order like an explosive manner between the same magnetic poles (for example, between the S pole of the electromagnet means 3 and the pole S2 of the magnet apparatus 2 in Fig. 1A), and there occurs a phenomenon that the lines of magnetic force in this portion collapse at a time of attraction between the different magnetic poles (for example, the N pole of the electromagnet means 3 and the pole S1 of in the magnet apparatus 2 in Fig. 1A). The magnetic field between pole S2 of the magnet 21 and the S pole of the fork-like electromagnet means 3, which should generally have a repulsive operation, generates a spherically exploding phenomenon, the collapsed lines of magnetic force mentioned above are violently flowed toward the

center portion of the exploding-like magnetic field, and operations due to this flowing phenomenon and the exploding-like phenomenon generate a further synergetic effect so as to generate a great rotational torque, so that the rotary body 1 is rotated. Further, this simultaneously smoothens the rotation itself of the rotary body 1 so as to stabilize the rotational movement and prevent a sound from being generated.

The two phenomena mentioned above ceases at a time when the fork-like electromagnetic means 3 is displaced over a position shown by dotted lines Nb and Sb in Fig. 1A, that is, at a time when the rotary body 1 is rotated to the position mentioned above, and an inverse operation, that is, an inverted rotational torque is generated at this time. Accordingly, the structure is made such that the excitation to the electromagnet means 3 is stopped at a time when the rotary body 1 reaches the position mentioned above so as to be discouraged (Nb, Sb → Eo), the inverted rotational torque is prevented from being generated in the rotary body 1, and the rotary body 1 is not prevented from being accelerated. When the lines of magnetic force become violently flowed into the magnetic field between the same magnetic poles, the rotational force is increased in proportion thereto, and a flux density becomes high,

or the rotary body 1 is accelerated, whereby the lines of magnetic force are violently collapsed, and the magnitude of the exploding phenomenon is increased. Accordingly, a speed of the rotary body 1 is gradually increased, and it is possible to effectively take out the rotational energy by a little electric energy in accompany with the operation according to the formula mentioned above. Here, in the case that one set of electromagnet means 3 are provided for each of the permanent magnet apparatus 2 in the rotary body 1 as in this embodiment 1, the structure may be made such that the both are simultaneously intermittently encouraged and discouraged, or two sets of electromagnet means 3 are combined to one pair and apply to the respective magnet apparatuses 2 in relays.

Detection of the rotational position of the rotary body 1 for intermittently encouraging and discouraging the electromagnet means 3 is performed by detecting means provided in the control unit 4. As the detecting means, it is possible to perform by means of a brush type mechanical method conventionally used in an electric motor or the like, or optional means such as a Hall IC, an optical sensor or the like.

In this case, as shown in Fig. 1, on the assumption that the rotational direction of the rotary body 1 is

a clockwise direction, it is possible to define a time at which the electromagnet means 3 is positioned in a position of two dotted lines shown by Na and Sa as a starting point So for encouraging (exciting). That is, a position detecting is performed at a time when a substantially center of a first magnet 21 (the magnet 21 having the magnetic pole pair shown by N1-S1) becomes a position of the dotted line Na (the position coinciding with the center of the N pole of the electromagnet means 3) and the S pole of a second magnet 21 (the magnet 21 having the magnetic pole pair shown by N2-S2) becomes a position of the dotted line Sa (the position coinciding with the center of the S pole of the electromagnet means 3), and setting of the control unit 4 is simultaneously performed so that the power source is turned on at this position. Accordingly, the start point So for encouraging is determined. In the same manner, the position detecting is performed and the setting of the control unit 4 is performed so that the power source is turned off, at a time when the rotary body 1 is manually rotated and the dotted line Na moves to the position shown by the dotted line Nb (at this time, the dotted line Sa is at the position shown by the dotted line Sb). Accordingly, a terminal point Eo for discouraging (a point for turning off the power source) is determined.

In this case, since the electromagnet means 3 is fixed, the magnet apparatus 2 side actually moves with respect to the dotted line Na and Sa. In this embodiment, the electromagnet means 3 is structured as mentioned above so that the electromagnet means 3 is extended between the first magnet 21 and the second magnet 21 in the magnet apparatus 2, however, the structure can be made such that a length of the yoke 34 in the electromagnet means 3 is adjusted, for example, so as to extend between the first magnet 21 and the third magnet 21 in the magnet apparatus 2.

The discouraging is unavoidable for the purpose of preventing the inverted rotational torque from generating. However, since the rotational torque having a high efficiency can be obtained even by intermittently encouraging, it is unnecessary to supply an electric energy without interruption. Accordingly, since the coils C1 and C2 of the electromagnet hardly generate the heat, a heat loss and a damage due to the heat become extremely small, so that this serves a protection of the coil.

Next, there is shown data obtained by executing an experiment by using the permanent magnet having the magnetic flux density of about 1100 gauss in the magnetic force rotating apparatus in accordance with the

embodiment 1. The rotary shaft of the rotary body is connected to the rotary shaft of the power generator, the rotary body is rotated by applying the electric current to the electromagnetic means, and a power generation is performed. An amount of power generation is measured in accordance with a dead short circuit method. On the other hand, an electric power consumed by the electromagnet means is calculated by reading numerals of an electric voltage and an electric current on a dial plate in the power source, and the amount of power generation and the amount of power consumption are compared. A lot of measured results indicate that the amount of power generation is 1.5 times or more of the input amount. This result clearly shows a relation of the input 1 to the output 2 obtained by the simultaneous application of the repulsive force and the attraction force.

After that, the power generator is taken out, the rotary body is rotated by using one rod-like electromagnet, and on the other hand, the rotary body is rotated by using the electromagnet shown in the embodiment 1 in accordance with the present invention. The consumed electric powers of both are compared after setting the rotational numbers to be the same in both cases. As a result, it is known that the former has

the amount of the electric power consumption at triple or less more than the latter.

In this case, the electromagnet means 3 shown in Fig. 3 is formed in a fork shape by winding the coils C1 and C2 around the shafts 31a and 31b so as to connect in series and setting the yoke 34 to the magnetic path constituting means, however, the structure may be made such as to wind the coils C1 and C2 around the yoke 34 portion, and form the end portion of one shaft 31a and the end portion of another shaft 31b to be the N pole (or the S pole) and the S pole (or the N pole) respectively so that two different magnetic fields are simultaneously generated from both of the magnetic poles N and S (the same modification can be applied to each of embodiments described below). The electromagnet means having the structure mentioned above can achieve the same operation as that of the electromagnet means shown in Fig. 3 in principle. Further, the structure can be made such as to use the yoke 34 of the electromagnet means 3 shown in Fig. 3 as a simple supporting and fixing member for both of the electromagnets 32a and 32b incapable of forming the magnetic path, and form the end portion of one shaft 31a in the side opposing to the permanent magnet apparatus 2 and the end portion of another shaft 31b to be the N pole (or the S pole) and the S pole (or the

N pole) respectively so that two different magnetic fields are simultaneously generated from both of the magnetic poles N and S (the same modification can be applied to each of the embodiments described below, in the same manner as mentioned above). When the structure is constituted in this manner, it is possible to satisfy the principle shown by the formula 1 mentioned above.

Figs. 4A and 4B show another embodiment 2 in accordance with the present invention, in which Fig. 4A is a front elevational view of a magnetic force rotating apparatus and Fig. 4B is a side elevational view thereof. These drawings correspond to Figs. 1A and 1B in the embodiment 1. In this embodiment 2 and the other embodiments described below, the same reference numerals are attached to the same elements as those of the embodiment 1 in order to avoid a double description and the description will be simplified. Accordingly, the following description is given only of differences and characteristic structures.

A magnetic power rotating apparatus in accordance with the embodiment 2 is provided with a pair of permanent magnet apparatuses 2A provided along the outer peripheral portion of the rotary body 1 and a balancer 5 provided so as to keep a balance with the magnet apparatus 2A. The permanent magnet apparatus 2A has

a larger number of permanent magnets 21 than the embodiment 1 and is arranged along a half circumference of the rotary body 1. A mounting state of each of the magnets 21 is the same as that mentioned above. The balancer 5 is structured such that a plurality of balancer blocks 51 are arranged along about a half circumference or less of the rotary body 1 in the same manner as that of the magnet apparatus 2A at a predetermined interval, thereby keeping a rotational balance of the rotary body 1. In this case, the balancer 5 may be structured such that one balancer is placed in the rotary body 1 so as to keep a rotational balance. The other structures are the same as that of the embodiment 1.

The magnetic force rotating apparatus in accordance with the embodiment 2 is structure as mentioned above. In accordance with the structure, in addition to the operations and effects of the embodiment 1, since an encouraging time becomes long and accordingly an accelerating time becomes long, it is possible to further increase an increasing effect of the rotational energy. In accordance with the embodiment 2, since the portion of the balancer 5 rotates without being accelerated only due to a moment of inertia, a dispersion easily occurs in the

rotation, however, it is possible to cope with an impulsive load change by mounting a fly wheel or the like. Further, the structure can be made such that two sets of rotary bodies 1 in which the magnet apparatus 2A and the balancer 5 are arranged as mentioned above are attached to the same rotary shaft 11 (in this case, the magnet apparatus 2A in one rotary body 1 and the magnet apparatus 2A in another one have a symmetrical positional relation), two sets of electromagnet means 3 are set, and these electromagnetic means 3 are encouraged in relays. When employing the structure mentioned above, it is possible to obtain a rotational torque having a large horse power by a little electric energy and it is possible to solve the problem concerning the dispersion of rotation mentioned above.

Figs. 5 to 7 show the other embodiment 3 in accordance with the present invention, in which Fig. 5A is a front elevational view of a magnetic force rotating apparatus, Fig. 5B is a side elevational view, Fig. 6 is a perspective view showing a state before mounting of a single piece of a permanent magnet, and Fig. 7 is a diagram of an electric circuit of electromagnet means.

A magnetic force rotating apparatus in accordance with the embodiment 3 is different from the embodiment

1 in view of a mounting aspect of the permanent magnet apparatus, an arranging aspect of the electromagnet means and the like. That is, in accordance with this embodiment, two sets of permanent magnet apparatuses 2B are arranged along an outer peripheral surface of the rotary body 1A and in such a manner as to oppose to each other with respect to the rotary shaft 11 in the center, thereby being provided with keeping a balance. Further, the electromagnet means 3 is structured such that two sets of electromagnet means constitute one pair and are set in a rotating space area in both sides of the rotary body 1A.

A plurality of permanent magnets 21 in the magnet apparatus 2B mentioned above are structured such as to position one magnetic pole (N pole in the illustration) among mutually corresponding magnetic poles in one side surface portion of the rotary body 1A in such a manner as to direct to a rotational direction, and another magnetic pole (S pole in the illustration) in another side surface portion of the rotary body 1A in such a manner as to direct to a inverse rotational direction, apply a substantially fixed angle of incline θ to the side surface of the rotary body, arrange the adjacent magnets 21 at a substantially uniform interval with respect to the circumferential direction in such a

manner as to partly overlap the adjacent magnets 21 with each other, and protrude each of the magnets 21 along the outer peripheral surface of the rotary body 1A so as to be fixed. In this embodiment, a bolt 24 is mounted to each of the magnets 21 via a pedestal 23 (refer to Fig. 6), the bolt 24 is inserted to an axial hole (not shown) provided so as to be directed from an outer peripheral surface of the rotary body 1A toward a recess portion 12 of the rotary body 1A, and each of the magnets 21 is mounted to the rotary body 1A by fastening and fixing with a nut 25. Accordingly, the magnet apparatus 2B is structured such that one magnetic pole N protrudes to one side surface portion of the rotary body 1A, and another magnetic pole S protrudes to another side surface portion of the rotary body 1A.

The electromagnet means 3 mentioned above is structured such that two sets of the electromagnets constitute one pair, and the respective coils C1, C2, C3 and C4 of the respective electromagnets 32a and 32b in this one pair of electromagnet means 3 are connected so as to be simultaneously encouraged (excited) as shown in Fig. 7. The one pair of electromagnet means 3 mentioned above are, as shown in Fig. 5, positioned on both surfaces of the magnet apparatus 2B, and are arranged as right and left pair so as to oppose to the

magnetic fields from one magnetic pole N and another magnetic pole S in the magnet apparatus 2B. Only one set of the one pair of electromagnet means 3 may be provided, or plural sets may be provided. In the case that plural sets are provided, each set of electromagnet means may be simultaneously encouraged and discouraged, or may be the plural sets may be encouraged and discouraged in relays.

Since the magnetic force rotating apparatus in accordance with the embodiment 3 makes good use of the magnetic force energy of both surfaces in the magnet apparatus 2B as mentioned above, not only it is possible to take out a rotational energy just twice of that in the case of using one surface, but also it is possible relatively cancel a force application to directions other than the rotational direction due to encouragement applied from both surfaces of the magnet apparatus 2B. Accordingly, a stability of the rotational motion is further improved, and the operation can be performed smoothly with a less sound without being affected by the inversed rotational torque.

Figs. 8A and 8B show the other embodiment 4 in accordance with the present invention, in which Fig. 8A is a front elevational view of a magnetic force rotating apparatus and Fig. 8B is a perspective view

showing a main portion of the apparatus. The embodiment 4 corresponds to a magnetic force rotating apparatus in accordance with the embodiment 3 characterized by mounting means of the permanent magnet to the rotary body. That is, in accordance with this embodiment, fitting grooves 12 to which the permanent magnets 21 are fitted are provided in the outer peripheral portion of the rotary body 1B at a predetermined interval in a circumferential direction and with a predetermined angle of incline with respect to the side surface of the rotary body 1B, and the magnets 21 are fitted to these grooves 12 so as to be fixed in accordance with optional means such as bonding, screwing or the like, so that a plurality of magnets 21 are arranged under the same condition as that of the embodiment 3 so as to constitute one set of permanent magnet apparatuses 2C.

In this case, one magnetic pole N of each of the magnets 21 constituting the magnet apparatus 2C is protruded to one side surface portion of the rotary body 1B, and another magnetic pole S is protruded to another side surface portion of the rotary body 1B. Moreover, when this structure is employed, it is possible to easily mount the magnet 21. The other structures are the same as those of the embodiment 3 and the same operations

can be achieved.

Fig. 9 shows the other embodiment 5 in accordance with the present invention, in which Fig. 9A is a front elevational view of a magnetic force rotating apparatus and Fig. 9B is a side elevational view. This embodiment 5 can be provided as an aspect of combining the embodiment 2 with the embodiment 3. In this embodiment, in order to avoid a double description, the same reference numerals are attached to the same elements as those of the embodiment 3, a description thereof will be omitted and a description will be given of only the characteristic features.

A magnetic power rotating apparatus in accordance with the embodiment 5 is provided with a set of permanent magnet apparatuses 2D provided along the outer peripheral portion of the rotary body 1A and a balancer 5A provided so as to keep a rotational balance with the magnet apparatus 2D. The magnet apparatus 2D is structured such that a plurality of permanent magnets 21 are arranged in the same manner as that of the embodiment 3, mounted to the outer peripheral surface of the rotary body 1A in the same means and arranged along a half or more periphery of the rotary body 1A. The balancer 5A is constituted by one semicircular ring-shaped balancer 51A, and the balancer 51A is fixed

along the outer peripheral surface of the rotary body 1A with the bolt 52 and the nut 53 in the same manner as that of the magnet 21 in the magnet apparatus 2D, thereby keeping a rotational balance of the rotary body 1A. In this case, the balancer 5A may be structured such that a plurality of balancer blocks are arranged on the outer peripheral surface of the rotary body 1A at a predetermined interval so as to keep a rotational balance. The other structures are the same as that of the embodiment 3.

The magnetic force rotating apparatus in accordance with the embodiment 5 is structure as mentioned above. When employing the structure, in addition to the operations and effects of the embodiment 2, since magnetic force energies on both surfaces of the magnet apparatus 2D can be well used, it is possible to take out the double-increased rotational energy in the same manner as that of the embodiments 3 and 4.

In the magnetic force rotating apparatus in accordance with the embodiment 5, the magnet apparatus 2D mentioned above may be structured in the same manner as that of the embodiment 4 such that the fitting grooves to which the magnets 21 are fitted are provided in the outer peripheral portion of the rotary body and each of the magnets 21 is fitted and fixed to the groove so

as to be arranged. In this case, the balancer 5A is fixed along the outer peripheral portion of the rotary body 1A or the balancer 5A is separated into a plurality of balancer blocks and each of the balancer blocks is fitted to the fitting groove having the same structure as that mentioned above so as to be fitted to the rotary body 1A.

Fig. 10 is a side elevational view showing the other embodiment 6 of a magnetic force rotating apparatus in accordance with the present invention, and Fig. 11 is a perspective view showing a mounting and arranging state of a single piece of a permanent magnet constituting a permanent magnet apparatus in the rotating apparatus. This embodiment is characterized by a structure of the permanent magnet apparatus and a positional relation for placing electromagnet means.

The embodiment 6 is provided with two sets of permanent magnet apparatuses 2E and these permanent magnet apparatuses 2E are provided along a circumference in an outer peripheral portion of a rotary body 1C with keeping a rotational balance. These magnet apparatuses 2E are structured in the same manner, such that a plurality of permanent magnets 21 are arranged so as to correspond directions of the magnetic poles to each other, position one magnetic pole S in an outer

peripheral side of the rotary body 1C and position another magnetic pole N in an inner peripheral side of the rotary body 1C (in this case, the positions of the S pole and the N pole may be inverted), and the magnetic pole pair (a line connecting the S pole to the N pole) of each of the magnets 21 are arranged at a substantially uniform interval in a circumferential direction with a substantially fixed angle w with respect to a radial line L of the rotary body 1C. In this embodiment, engaging grooves 13 with which the magnets 21 are engaged are provided in the outer peripheral portion of the rotary body 1C at a predetermined interval in the same circumferential direction, the magnets 21 are engaged with these grooves 13 and fixed thereto by means of boding, screwing or the other. In this case, a number of the magnets 21 (three in the illustration) constituting one set of magnet apparatuses 2E can be optionally increased or reduced.

The electromagnet means 3 is provided close to the magnet apparatus 2E of the rotary body 1C. The electromagnet means 3 is provided so as to be positioned in such a manner as to generate two different magnetic fields simultaneously applied as a rotational energy in one direction with opposing to the magnetic field from the magnet apparatuses 2E mentioned above. In this

embodiment, both magnetic poles N and S of the electromagnet means 3 are respectively positioned so as to be close to the magnet apparatus 2E and oppose to the circumferential surface of the rotary body 1C, and are provided by fixing and supporting with a supporting member. While illustrated electromagnet means 3 is structured such that two rod-like electromagnets 32a and 32b connected in series via the magnetic path constituting means 34 (the yoke) are provided in parallel in an opposing manner, it may be provided in an opposing manner so that axes of both of the electromagnets 32a and 32b are directed in a radial line direction of the rotary body 1C. Further, although there is disclosed in the illustration the structure in which one set of electromagnet means 3 are provided, two sets may be provided in the same manner as that of the embodiment 1. Besides, in the case that a large space exists between the magnet apparatus 2E and the rotary shaft 11, the structure may be made such that the electromagnet means 3 is provided so as to be directed to the outer peripheral direction of the rotary body 1C and oppose to the magnetic field of the magnet apparatus 2E. The other structures are the same as those of the embodiment 1.

The embodiment 6 is structured in the manner

mentioned above. The particular structure of the magnetic force rotating apparatus is different from that of the embodiment 1 in view of the mounting and arranging relation of the permanent magnet 21 and the positional relation of the electromagnet means with respect to the rotary body 1C. However, since the application (repulsion and attraction) of the same magnetic poles and the different magnetic poles between the electromagnet means 3 and the permanent magnet apparatus is not changed, substantially the same operation as that of the embodiment 1 can be obtained.

Fig. 12 is a side elevational view showing the other embodiment 7 of a magnetic force rotating apparatus in accordance with the present invention. This embodiment 7 is provided as an aspect of combining the embodiment 6 with the embodiments 2 or 5 . In this embodiment, the same reference numerals are attached to the same elements as those of the embodiment 6, a description will be simplified and given of only the characteristic features.

A magnetic power rotating apparatus in accordance with this embodiment is provided with a set of permanent magnet apparatuses 2F provided along the outer peripheral portion of the rotary body 1D and a balancer 5B provided so as to keep a rotational balance with the

magnet apparatus 2F. The magnet apparatus 2F is structured such that a plurality of permanent magnets 21 are arranged in the same manner as that of the embodiment 6, mounted to the outer peripheral surface of the rotary body 1D in the same means and arranged along about a half periphery of the rotary body 1D. The balancer 5B is constituted by one semicircular ring-shaped balancer 51B (which may be separated into plural numbers), and the balancer 51B is fixed to the rotary body 1D by fixing means 52 such as screwing or the other, thereby keeping a rotational balance of the rotary body 1D. The other structures are the same as that of the embodiment 6.

The embodiment 7 is structure as mentioned above. The particular structure of the magnetic force rotating apparatus is different from that of the embodiment 2 in view of the mounting and arranging relation of the permanent magnet 21 and the positional relation of the electromagnet means 3 with respect to the rotary body 1D. However, since the application (repulsion and attraction) of the same magnetic poles and the different magnetic poles between the electromagnet means 3 and the permanent magnet apparatus is not changed, substantially the same operation as that of the embodiment 2 can be obtained.

Each of the embodiments mentioned above is disclosed as an example of embodiment, and it is a matter of course that the present invention is not limited to these embodiments and can be suitably changed and modified so as to be put into practice within the range of the technical matters described in the claims.

INDUSTRIAL APPLICABILITY OF THE INVENTION

The magnetic force rotating apparatus in accordance with the present invention is suitable for being used in an ultra energy saving motor, a power motor of a power generator, an engine of a motor vehicle or the like.